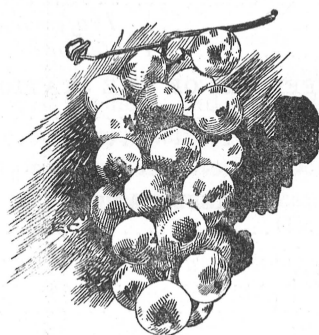

Cornell University—Agricultural Experiment Station.

HORTICULTURAL DIVISION.

BULLETIN 76—November, 1894.



SOME GRAPE TROUBLES

OF

WESTERN NEW YORK.

By E. G. LODEMAN.

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Those desiring this Bulletin sent to friends will please send us the names of the parties.

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CORNELL UNIVERSITY, ITHACA, N. Y., NOV. 1, 1894.

THE HONORABLE COMMISSIONER OF AGRICULTURE, ALBANY.

Sir: The following account of some of the difficulties in the way of grape growers in the Fifth Judicial Department of New York, is submitted as a bulletin to be published under the provisions of Section 87, Chapter 675, of the laws of 1894.

The trouble known as "rattles" has been very serious the past season, particularly in the Chautauqua region. We have made a thorough study of it in the field, and the following paper is believed to contain the best information obtainable concerning it. Definite and perhaps prolonged experiment upon an extended base is needed, however, to discover the exact cause and to suggest specific remedies.

Grape growing is one of the leading industries of the state, and its area is increasing. The extent and distribution of the acreage in western New York are approximately as follows:

Chautauqua region,	-	-	-	-	26,000	acres.
Canandaigua	"	-	-	-	5,000	"
Keuka	"	-	-	-	10,000	"
Seneca	"	-	-	-	6,000	"
Cayuga	"	-	-	-	3,500	"
Scattering, -	-	-	-	-	7,500	"
Total, -	-	-	-	-	58,000	acres.

L. H. BAILEY.

SOME GRAPE TROUBLES OF WESTERN NEW YORK, 1894.

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PART I—IN CHAUTAUQUA COUNTY.

A. SHELLING OR RATTLING (pages 413 to 440).

Many grape growers of Chautauqua county have this year lost a considerable portion of their grapes on account of the berries dropping to the ground before they were fully mature. This condition is commonly known as the "shelling" or the "rattling" of the grapes. Its unusual prevalence and the severity of the attacks in some vineyards have caused the vineyardists much uneasiness regarding the losses caused and the possible extent to which the trouble may affect the vines in the future. During the past fall it has appeared more or less seriously throughout the region of the Chautauqua grape belt, and some portions of central New York have not entirely escaped its presence.

The trouble is not a new one. It has been familiar to observing vineyardists for fully twenty-five years, and it is probable that it has existed even longer. It is the severity of the attack which has this fall affected the vines that has made the Chautauqua vineyardists in particular anxious regarding the cause of the trouble and the remedies which may be applied to prevent its reappearance.

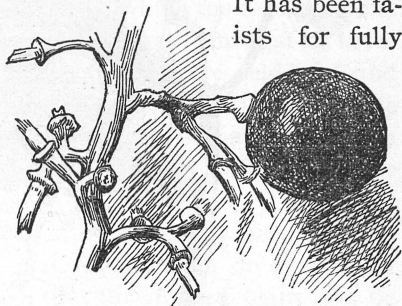


FIG. 1.—Normal separation of berry from the stem.

Description.—The shelling of grapes takes place in the following manner. As the season of ripening approaches, certain berries of the affected clusters fall to the ground on account of the inability of the main fibres and other connecting tissue of the fruit-stems to sustain their weight. Figure 1 represents a normal separation of the berry from the stem as commonly pulled off; Fig. 2 shows the manner in which this separation takes place in the case of shelling. The end of the stem is even, as if cut with a knife.

The portions of the cluster first affected are, so far as my observations go, invariably either the lower extremity of the cluster as it hangs from the cane, or, in the case of heavily shouldered clusters, the outer extremity of the stem forming the shoulder. The shelling may begin at both points at about the

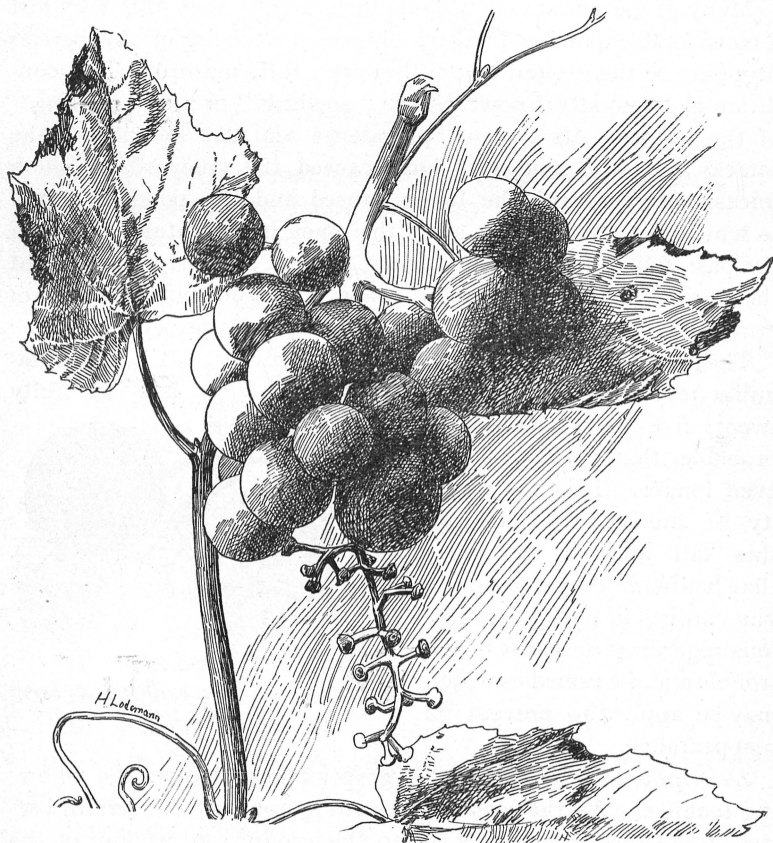


FIG. 2.—*Abnormal separation of berry from stem, as it occurs in shelling.*

same time, but it generally makes its appearance first at the lower end of the bunch. Sometimes only one or two berries may fall, but in other cases the drying and shriveling of the stem gradually extends upward, the affected portion being plainly marked by the absence of the berries, as shown in Fig. 2. It often

occurs that not a berry remains hanging upon the bunch. In such cases the ground below the bearing portions of the vine is literally covered with the fallen fruit, and from a distance it presents, in the case of Concords, a strong blue color.

Some clusters upon a vine seem to be more free from shelling than others upon the same plant. This seems to be due in many cases to its location upon the cane, but there are so many exceptions that no definite rule can be laid down. In general, however, it may be said that of the clusters found upon a certain cane the one which is situated farthest from the main stem of the plant is most seriously affected. There are many exceptions to this statement, but the majority of cases which I have seen confirm it.

Another peculiarity which may sometimes be seen, although cases of it are very rare, is the shelling of berries upon only one portion of the vine, as for instance those borne upon the canes which spring from an arm, the difficulty thus affecting only one-half of the plant. One case was noticed in which the clusters found upon one cane were the only ones which suffered, amongst all those borne by the vine. The fact that such cases are seldom found would tend to show that they represent a singular phase of the disease, and are produced by some local cause, perhaps varying in the different cases. They cannot be considered as typical of the common form in which it appears.

It very commonly occurs that plants in certain portions of a vineyard shell, while the large majority of them do not. The line is sometimes so sharply drawn that the affected plant may be entirely surrounded by healthy vines; and it is not uncommon to find a healthy vine in the midst of those which shell. Occasionally the plants in a row are quite different as regards the amount of fruit which is lost, some retaining all, while others lose fully 75 per cent. Such vineyards, however, do not represent the large majority. In these, the shelling is more or less uniform throughout the vineyard, and only in exceptional cases does the loss reach 50 per cent. of the crop. The total loss in the "belt" will probably not exceed 5 per cent. of the entire yield this year.

The taste of shelled grapes differs decidedly from that of those remaining upon the upper portion of affected clusters and still more from that of berries which are borne upon vines in which no

shelling takes place. This difference is very noticeable in Concord. Grapes of this variety, when grown under favorable conditions, are sweet and very agreeable to the taste, on account of a flavor which is peculiar to the variety. Shelled grapes are extremely insipid, and are unpalatable not only from a want of taste but also from a certain disagreeable flavor which, though seldom strong, is still perceptible. Berries which remain upon shelly vines lack flavor, but otherwise they do not appear to possess any particularly disagreeable qualities.*

Vines which have shelly grapes are almost invariably affected by what is commonly called the leaf-blight. This generally appears late in July or during August. This year it came on late in August and during the first week of September, which is about the time that the grapes began to fall from the vines. The blight causes the death of the leaf tissues, but all the leaves do not appear to be equally affected. The younger growths are the ones which suffer most. The leaves at the outer extremities of the shoots first show a yellow discoloration which follows more or less continuously the outer margin. Soon this yellow portion dies and turns brown. This causes the leaf to curl at the edges as shown in Fig. 3. As the disease progresses, older leaves are affected and in severe cases the amount of brown in the foliage is noticeable from a considerable distance. Many of the vineyards showed this discoloration so plainly that it was not necessary to enter them to be assured that the grapes were shelling.

The shelling of grapes is not invariably accompanied by any decided discoloration of foliage, nor is the browning of the leaf tissue a certain indication of shelling; but the few exceptional cases in which the one takes place without the other scarcely have sufficient weight to throw any serious doubt upon the probable relation existing between the two. I have been assured by several

* Chemical analyses of shelling grapes are now being made with the hope that some light may be thrown upon the subject by the berries themselves. In addition to this, fertilizer experiments have been planned and several are now under way to determine the kinds and amounts of fertilizers that are necessary to the proper maturing of a crop of grapes, and also to find what amount of fruit can regularly and profitably be borne by a vine without injury to it. The results of these investigations should be published as soon as definite statements can be made.

growers that in years past they have been able to tell during the summer which vineyards would shell during the fall, basing their

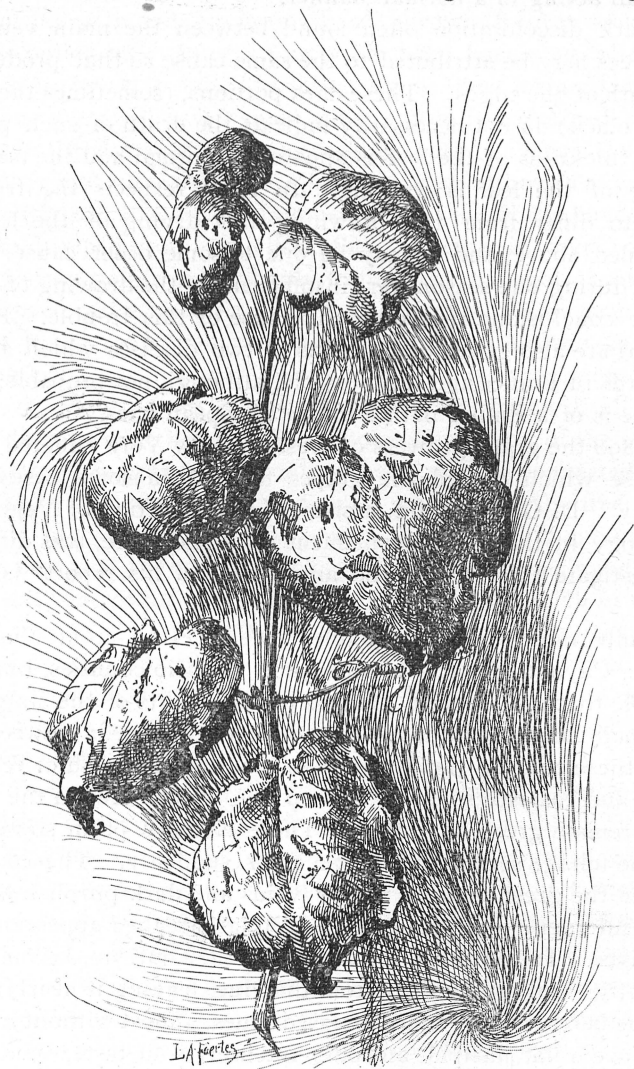


FIG. 3.—*Diseased foliage upon a shelling vine.*

conclusions entirely on the fact that the foliage began to assume this brown tinge. The leaves are not often entirely destroyed,

for they remain upon the vines until fall, the green portions probably still acting in a normal manner.

A dark discoloration often found between the main veins of the leaves may be attributed to the same cause as that producing the death of the edges. These dark portions, (sometimes they are nearly black) do not necessarily indicate the death of such places for the thickness of the leaf is apparently normal and the marked curling of the leaf is wanting. In these respects the trouble seems to differ from the browning and drying of the leaf as mentioned above, and it may be due to some other cause. Inquiries during one season were insufficient for the drawing of more definite conclusions regarding the cause of this trouble. Below (p. 420) are also given descriptions of two diseases which attack vineyards in France and it is possible, although not probable, that this one is of a similar nature to the European ones.

In 1890 the grape growers of western New York suffered from a disease which caused the grapes to shell in some cases very severely. D. G. Fairchild, assistant in this section of Vegetable Pathology in the U. S. Department of Agriculture, was directed to investigate this trouble and an abstract of his report* is here given.

Definite reports of the trouble were received from Niagara, Wayne, Cayuga, Seneca, Steuben and Ontario counties, but it is probable that grapes were affected in other parts of the state.

"Small irregular bunches of a dark color appear between the veins, these enlarge rapidly, darken to a dull purplish or reddish brown and coalesce so as to fill up the space between the veins which remain green or yellow. These changes occur so rapidly that the foliage seems to change color suddenly. The contrast between the green or light yellow veins and dark purplish brown of the intervening tissues gives a peculiar streaked appearance to the leaves. In the most serious cases they curl up, become dry and brittle, and finally drop from the vine, leaving it nearly bare.

"The berries borne upon diseased vines, almost without exception, have a flat, insipid, and often intensely sour taste, due to the fact that they are only partially ripened. When the attack is severe the berries drop off, and the ground beneath a diseased vine is often

* Journal of Mycology, vi. 96. Annals Hort. 1890, 74.

seen to be covered with half ripe grapes. The berry is found to part from its pedicel taking with it the fibres which enter the interior of the pulp and are normally withdrawn from it when the berry is pulled off. After the crop has been harvested, also, the bunches are found to 'shell' badly, ruining them for market.

"The roots of diseased vines, when carefully examined, fail to show a healthy growth of young feeding rootlets. When the roots of healthy and unhealthy vines are compared, although as is to be expected late in the season (October 20-25) the fibrils have many of them dropped from all vines, the difference in favor of the healthy vines points quite plainly to the fact that root absorption was stopped earlier where the disease is present. The early stoppage of the action of the rootlets may account for the peculiar coloring of the leaves and failure of the canes to mature their wood. * * * A careful microscopic examination of all parts of the diseased vine has revealed absolutely nothing of the nature of a parasitic fungus which could in any way be connected with the malady. Leaves, canes and roots seem perfectly free from any form of parasitic plant or animal. * * * In general it may be said that the worst attacks of the disease occur upon cold, heavy soil containing a large percentage of clay and rich in nitrogenous matter. * * * So far as the investigation goes there seems to be no connection whatever between the fertilizer used and the trouble, diseased plants being found upon land unmanured, heavily manured, fertilized with phosphates, wood ashes, and bone dust."

The disease described by Fairchild is undoubtedly identical with the rattling or shelling of grapes as it occurred this fall, although the appearance upon the leaves has not been similar to that observed the past season. From somewhat incomplete meteorological data, I find that in general the season of 1890 resembled that of 1894. The spring was very wet, the summer inclined to be dry, and the months of September and October very wet.

In this connection it may be well to mention two diseases which attack French vineyards. They are frequently spoken of in connection with the shelling of grapes, and to assist in clearing up the problem the two diseases are described. The causes of apoplexy and rougeot are apparently clear, and meteorological con-

ditions may be held responsible for their appearance. When we come to the origin of grape shelling, the same causes do not appear, and meteorological influences seem to assume but a secondary position.

Apoplexie, or Folletage.*—These are the names applied to a phenomenon which generally appears in July or August in vineyards, especially in those growing on deep and rich soils, which previously showed no signs of disease. Upon isolated plants, or sometimes upon entire portions of a vineyard, there suddenly appear leaves which have lost their lustre, and their natural turgescence; in consequence they wilt and perish. The shoots dry from above downward, and soon the entire plant dies. The trouble however, is not always so severe as to cause the death of the plant. One portion only of the plant may be affected and the remainder be apparently healthy. But the shock to the plant is always severe, and generally the effects of such an attack are beyond perfect repair. The explanation which Leclerc gives† is as follows: "The rainfall during the year has been very heavy and thus prevented the rapid heating of the soil and also caused the atmosphere to be saturated with the vapor of water. In addition, the skies of Touraine have been almost constantly overcast. The growth of the vines was made, one might almost say, in the shade, and under these circumstances the tissues of the plant have not acquired the powers of resistance which they would have had if the sun had shone oftener. The tissues were gorged with water; the evaporation from the plant was slow in consequence of the humid condition of the air. The experiments of Sachs show that transpiration (evaporation) increases as the temperature of the soil is raised. Consequently the passage of water through the roots and the wood must have been slow and a certain balance was established between it and the process of transpiration. Let us suppose, now, that suddenly the burning rays of the sun strike the well developed foliage of the vines. The air is warmed, dried more and more as the temperature increases, and with the increased heat and dryness of the air the evaporation of the plant becomes more energetic. Since the water lost from the leaves

*G. Foëx, Cours Complet de Viticulture, 1891, p. 466 *et seq.*

†Ibid. p. 467.

and green parts cannot be instantly replaced by the roots, on account of the rate of circulation already established, those parts wilt, and when they have dried to a certain point they perish." In conclusion, apoplexy may be said to be due to a disturbance of the equilibrium existing between the absorption of water by the roots and its evaporation from the leaves. No remedy is as yet known for the trouble. Thorough drainage may lessen its severity in some soils.

Rougeot appears, from the conditions which cause it and by its general nature, to be allied to apoplexy. Like the latter, it attacks vines in full growth, at the time of the first heated periods, and is most serious upon cool, deep soils. Thiébaud de Berneaud says* that the disease is produced "during summer, after a cold rain, a storm which causes a sudden fall of temperature, or a fog which is followed by warm southerly winds." Marès describes the disease as follows: "The leaves begin to change, shrivel and lose their suppleness. The parenchyma turns red while the veins remain green, which gives the foliage a very peculiar appearance. The berries wilt and the shoots remain yellow. If the trouble increases, the leaves dry entirely and the stems die partially, sometimes only one side being affected, the diseased portion extending from the extremity to the base of the shoot. Such shoots often start a later growth during the latter part of the season. Plants attacked by *rougeot* do not die, as in the case of apoplexy, but they are severely checked, and several years are necessary to a complete recovery." Drainage should be carefully attended to, and particular pains taken to prune short, or at least down to sound wood. In extreme cases the plant may be renewed by grafting low upon the trunk of the vine.

Ascribed Causes of the Shelling of Grapes.—The causes which lead to the shelling of grapes are very obscure. Although the trouble has existed a long time among the vineyards of Chautauqua county, there are still numberless theories advanced as to the influences which produce it. Nearly every grower has a theory regarding it, but many confess that the disease is a mystery, and that none of the theories advanced will properly explain its

* Ibid. p. 469, cited from *Nouveau Manuel complet du Vigneron Français*, p. 186.

appearance. The following are the more important of these possible causes :

1. Insects.
2. Fungi.
3. Blight of the foliage.
4. Stems shrivel before the berries mature.
5. Berries prematurely ripe.
6. Premature ripening of the wood.
7. Overbearing.
8. Too much wood and foliage.
9. Too rich land.
10. The kind of soil.
11. Too much cultivation.
12. Excessive drought.
13. Excess of moisture after drought.
14. A weak root system.
15. Want of barnyard manure.
16. Want of phosphoric acid.
17. Want of potash or of some other element.
18. Excessive heat.
19. South wind.
20. West wind.

Such a variety of opinions regarding the causes that produce the shelling of grapes should include some at least which offer the true solution of the problem. Before considering the list in detail, it may be convenient to divide these opinions into groups, basing the division upon the close relationship existing between many of them. They fall readily into four groups, as follows :

- I. Injuries caused by parasites : embracing Nos. 1-3.
- II. Improper condition of the vine : embracing Nos. 4-9.
- III. Condition of the soil : embracing Nos. 10-17.
- IV. Condition of the atmosphere : embracing Nos. 18-20.

The various opinions will be considered individually so that their real value may be properly estimated.

GROUP I.

Injuries caused by parasites.

1. *Insects*.—It is believed by many that much, if not all, of the shelling of grapes is due to the action of insects. This point was constantly kept in mind during the examination of vineyards, and both clusters and vines were searched for insects which might be supposed to cause the trouble. In not a single case, however, did I discover any pest to which could be attributed the shelling of the grapes, and this theory had to be abandoned from want of evidence. If the trouble is caused by an insect, it works "in ways that are dark and devious" and when found will prove to be very interesting.

2. *Fungi*.—A majority of the vineyards visited were found to be infested with powdery mildew (*Uncinula spiralis*). This was found growing abundantly upon the leaves and fruit-stems of some vines and traces of it could be found in almost every vineyard. This mildew appeared late and was not found upon any berries. It formed a white mealy coating upon the main stems of the clusters, but comparatively little was found upon the pedicels of the individual berries. Its presence upon the foliage could easily be detected by the silvery-gray appearance of certain portions of the upper side of the leaf, these areas being very plainly marked in those portions freely attacked. Almost the whole of this fungus rests upon the leaf, and only the suckers which are in search of nourishment enter into the leaf tissue. This permits the parasite to be rubbed off very easily and the only trace of its former existence upon the leaf is a darkening or blackening of the portion which was most thickly covered.

In severe cases this fungus will cause grapes to fall from the vines, for the following reason. Let us suppose that the stem of a cluster is thickly infested with the mildew. A great many suckers will be sent into the green portion of the stem and much nourishment will be taken away from the berries. Another effect will be to obstruct the free flow of sap and this will again cause the berries beyond the point of injury to be deprived of the materials which were originally intended for their use. "We sometimes find nearly full-grown berries completely overgrown with mycel-

ium of the *Uncinula* so that the brown specks above mentioned, [produced in the berries by the action of the suckers] if present at all, are completely hid from view. These berries eventually become dry and shrivelled, and finally drop off."*

If the shelling of grapes as it occurred this fall were entirely due to the presence of the powdery mildew, then the degree of shelling should be directly in proportion to the severity of the attack of the mildew. The vineyards, however, did not bear out this proposition. Vines in which scarcely a trace of mildew could be found, frequently lost a large amount of their fruit, and again many clusters were seen having their stems literally covered with the fungus, yet no berries fell to the ground. The frequency of such cases has led me to believe that the powdery mildew is not the principal cause of the shelling of grapes, although in certain cases it may have exerted an influence in this direction, and possibly some berries fell from this cause alone. The cause for the bulk of the shelling must be sought elsewhere.

3. *Blight of the foliage*.—By the term "blight" is meant the browning of the leaves as already fully described upon page 416. Affected portions have been examined under the microscope but no traces of insect or of fungous injury could be found. The manner in which the leaf succumbs indicates that the trouble is not local, but that something is wrong in the whole plant economy. Consequently it seems to be safe to say that the so-called blight is not a cause of the shelling of grapes, but it rather appears to be a condition resulting from the same causes which make the berries drop to the ground; in other words, the browning and dying of the edges of the leaves and of those portions situated farthest from the main vines is to the leaf what the dropping of the lower berries from a cluster is to that cluster. Neither is dependent upon the other, and both are the result of some common cause.

*Scribner's Report on the Fungous Diseases of the Grape Vine. U. S. Dept. of Agric. Bot. Div. Sec. of Veg. Path. Bull. II. p. 22.

GROUP II.

Improper conditions of the vine.

4. *Stems shrivel before the berries mature.*—From the peculiar manner in which the lower end of the stems of fruit clusters shrivel and dry, one would naturally be led to suppose that the green wood failed to ripen. This shrivelling of the stem necessarily cuts off the supply of nourishment from the fruit, which in consequence drops. But the true question now is, what is the cause of this shrivelling? When that is answered, we shall have the answer to the question regarding the cause of the shelling.

5. *Berries prematurely ripe.*—This is little more than a mere statement of the fact that when grapes are perfectly ripe they separate from the cluster in the same manner as do the shelled grapes. That this ripening is premature is evident, for the large majority of berries still remain upon the vines while the others are falling. This theory throws no light upon the cause of the trouble.

6. *Premature ripening of the wood.*—In case the wood of a grape vine ripened prematurely, it would undoubtedly exert an influence upon the fruit itself. The character of this influence would probably vary with the age of the berries. If a cane bearing clusters be broken during midsummer when the fruit is about one-half grown, the berries will not fall to the ground, but they will remain hanging upon the stems even after being perfectly dry and shrunken. Although such wood is not properly ripened, it resembles well ripened wood by not admitting of the free passage of nourishing elements. The same result is obtained when a certain portion of a cluster is girdled by anthracnose. If such accidents occur when the berries are fully grown or coloring, the effect may be different, for then there may be sufficient nourishment present to enable the berry to continue to ripen, although imperfectly, and to allow the natural separation of berry and stem to take place. But even if it is granted that the shelling of grapes is due to the premature ripening of wood we are still in search of the cause of this ripening.

7. *Overbearing.*—A vine overbears when it sets more fruit than it can ripen without interfering with the production of a sufficient

amount of healthy foliage and wood. Vines which have set too much fruit show it in the comparatively little amount of new growth, in the smaller size of the leaves and fruit, and in the slowness with which they ripen their fruit. There are, of course, many degrees of overbearing and appearances will not be identical in the different cases. In severe cases the berries grow slowly and color slowly, and they may remain unripe until very late in the season, or perhaps never ripen well. It has already been stated on page 425 that grapes must attain a certain degree of maturity before they part naturally from the stem. It is probable that in some severe cases of overbearing the berries never reach this point. I have seen, on Cayuga Lake, Catawbas which, during the season just passed, had only begun to color on October 5. Yet they did not shell. Other vines in the same vineyard, some having much better colored fruit, did lose a few berries. These vines appeared to be carrying too much fruit, still it was fairly well colored; similar cases were also seen in Keuka Lake vineyards.

The effects of overbearing are not limited to one season, but the plant may suffer for a year or two on account of the weak condition in which it was left at the close of the first, and it is not improbable that this weakened condition may be exhibited by the grapes shelling. Still, in visits paid to the vineyards of Chautauqua county the yield per acre seemed to have little connection with the degrees of shelling, and strong vigorous foliage was by no means a proof that the grapes were not shelling; in many cases it was quite the contrary as regards the character of the foliage. In fact, some growers have advanced the idea that the vigorous foliage was the cause of the trouble.

8. *Too much wood and foliage;*

9. *Too rich land.*—These two theories can properly be considered together as the last named is the cause of the other. Their origin probably lies in the fact that vines growing in strong black land, that which is commonly found in hollows and which is frequently called black walnut land, are particularly apt to shell, while vines growing on higher land hold their fruit. I have seen in the vineyards of Mr. E. H. Fay, Brocton, N. Y., rows which began to shell as soon as they dipped into this dark, loamy soil, yet just above no grapes fell. The land is undoubtedly rich, but is it rich

in the proper elements? Nitrogen is there in more than sufficient quantities, but other things than nitrogen are wanted for the perfecting of a grape crop, and it is very possible that some of those other elements may not be present in proper quantities to supply the demands of the larger amount of wood which has been made, as well as to ripen the fruit properly. In case there is not enough food the fruit will be the first to show the effects.

On higher land where the growth is not so rank, the demands of the ripening wood are not so great and the fruit is better cared for. Too much nitrogen, therefore, is detrimental to the profitable development of the grapes.

GROUP III.

Conditions of the soil.

10. *The kind of soil.*—That the shelling of grapes is worse as a rule upon some soils than upon others is a very common belief, and the subject is closely related to the two preceding. About Ripley, the soils which are supposed to produce shelling vines are the low rich lands, the higher ones being free. I found an exception to this rule in the vineyard of Mr. H. J. Lewis, and about Portland several cases could be mentioned in which the high land shelled as badly as the low. At Forestville it is a common saying that clay lands are free from the trouble, but there are many cases which contradict the statement. My observations have led me to the conclusion that the character of the land is not an indication of the degree to which the grapes will shell. This reservation should nevertheless be made: that lands which are rich in nitrogen, and which consequently make an unusually strong growth of wood and foliage, are strongly inclined to produce vines which shell, while lands making a normal amount of wood and healthy foliage are inclined to be free from the trouble.

11. *Too much cultivation.*—The effect of too much, or too late cultivation, is practically the same as that of feeding plants nitrogen. It cannot be denied that the amount of shelling found in poorly cultivated vineyards has on the whole been less than in those which have been well cultivated, other things being equal.

It is said that one grower boasts of harvesting from his vineyard two tons of hay and three tons of grapes per acre ; yet his grapes did not shell. I have seen a case* in which two men owned adjoining vineyards which were growing on the same land and had had the same treatment in past years. During the past season one had not been cultivated and the other had been. The latter shelled considerably, the former practically none. Vineyards that were growing nearly in sod were almost invariably free from the trouble. Many vineyards that were not cultivated also shelled, but unquestionably the well cultivated vineyards suffered more than those which were not so thoroughly tilled. The explanation for this fact is probably the same as that which will clear up the shelling of grapes upon the soils rich in nitrogen, since tillage promotes nitrification, which in turn causes a strong growth of wood.

12. *Excessive drought.*—Many attribute the shelling of grapes to the very dry weather. The grape season of 1894 was about ten days earlier than usual ; Catawbas colored and ripened to perfection, and the quality of all varieties was exceptionally good. These undoubtedly are results of the drought, and why should not shelling be equally so since it has been so unusually severe? Several objections can be raised to this theory. If the shelling was due to the drought entirely, vineyards upon the same soils should have suffered with the same uniformity with which their grapes colored and ripened, or received their excellent flavor. Again, if drought is the only cause of shelling, vineyards growing upon moist soil should have been free from the trouble. One vineyard belonging to Mr. E. H. Fay, of Brocton, N. Y., was planted upon soil which remained moist throughout the summer ; in fact, open ditches held running water during the worst of the dry weather. Nevertheless, this vineyard shelled, but not from want of water. It is situated upon the black rich land already mentioned and shelled probably for the same reason that others in similar situations did.

There seems to be, nevertheless, some connection between the prolonged dry weather and the shelling. It appears to me that this

* Messrs. Randall and Lewis, Ripley, N. Y.

connection can best be explained by the supposition that the dry condition of the soil prevented the plant food from going into solution, for unless it is in solution it cannot be taken up by the plant. This shortage of plant food, or defect of nourishment, would have a tendency to cause the plant to ripen its crop earlier than usual, which indeed did take place. But the grapes which fell to the ground were not fully ripened, nor were the majority of those which remained hanging upon these vines. The taste showed that there was something wrong in their development, that the sweetness and aroma proper to the variety were wanting. This was undoubtedly due to some defect in the nourishment of the berries, and this defect may have been and probably was intensified by the dry weather.

13. *Excess of moisture after drought.*—To what extent the rains which followed the drought influenced the shelling it is difficult to say. It is probable that the principal injury had already been done when these rains came, and the sudden supply of plant food may merely have hastened the last stages of the ripening of the berries and thus have caused them to fall a little sooner than they otherwise would have done. But to what extent this took place cannot be said.

14. *A weak root system.*—It is a generally conceded fact that young vineyards suffered more than old ones. Probably the severest cases could be found among vineyards which were bearing their second or third crop. Although many of the older vines suffered, the average loss from these was probably not so great as that from the younger plants. Since the younger plants were not so well established, they would not have the same opportunities of obtaining food as the older ones. The area covered by the roots would be smaller, they would not extend to an equal depth, nor would there be so many of them. This would result in an insufficient nourishment of the plant, a premature and probably an imperfect ripening of the fruit, and finally the falling of the berries. I think it very probable that in the case of the young vineyard belonging to Mr. E. H. Fay, already mentioned on page 428, that although the land was sufficiently rich in nitrogen it was lacking in some other equally important element; or, since the land itself is so very low and wet, it is very possible that it is not well adapted

to a healthy growth of the Concord grape. Either of these causes might tend to produce shelling.

That insufficient nourishment does cause grapes to shell is clearly shown in Figure 4. This Catawba cane was found in the vineyard of Messrs. King & Robinson near Trumansburg, N. Y. The first thing which attracted my attention was the light red color of the berries upon the central cluster. They were just

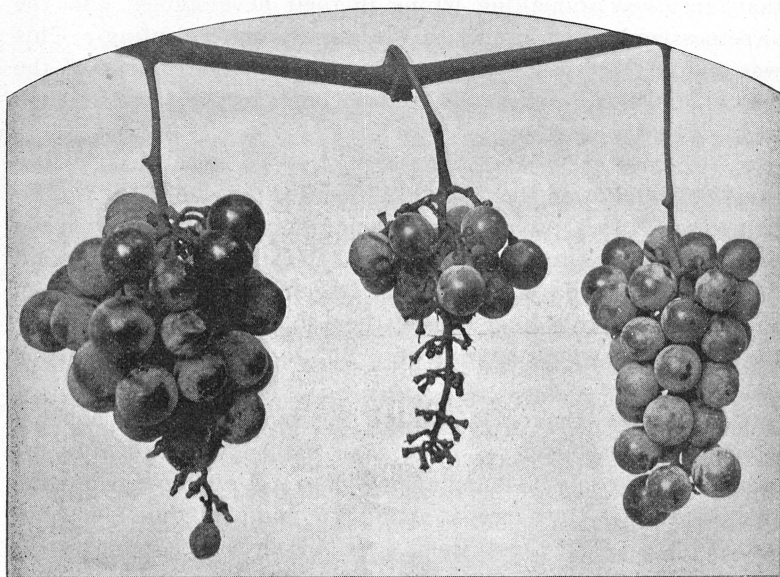


FIG. 4.—*Obstructed flow of sap the cause of shelling.*

turning, while the clusters on either side were colored a dark red. Upon closer examination the cause of the trouble became apparent. It will be seen in this illustration that the two outer clusters hang directly down from the underside of the cane. The stem of the central cluster, however, is attached on the upper side of the cane and the weight of the fruit has caused the stem to bend at a very acute angle, thus seriously interfering with the flow of sap.

Another interesting point was soon noticed. The lower berries

of the cluster separated in the same manner as that which takes place in the case of shelling; most of the berries parted regularly from the stem as if cut with a knife. The berries on the neighboring cluster parted in a different manner, for the connecting fibres remained attached to the peduncle, as shown in the figure. Here was positive proof that improper nourishment caused a marked weakening in the connection between berry and stem, and undoubtedly it was merely a matter of a short time before the berries would have shelled as completely as some others in the same vineyard were doing. With the others, however, it seemed to be a clear case of overbearing, which to the fruit is nothing more than a want of proper food.

15. *Want of barnyard manure.*—This cause for the trouble is here mentioned because Mr. H. B. Clothier, of Forestville, N. Y., assures me he has stopped the shelling by the use of barnyard manure which was taken from the stables of horses fed with grain. The use of stable manure, however, has not always been followed by such satisfactory results, and it may and sometimes does do injury by promoting an excessive growth of wood.

16. *Want of phosphoric acid.*—The lack of this substance in available form in the soil has been advanced as a possible cause of the grapes shelling. The use of phosphorus to the plant is very imperfectly understood. It is supposed to assist in the diffusion of soluble albuminoids, or those compounds which contain nitrogen. Nothing definite can be said of the relations existing between the shelling of grapes and the action of the phosphates.

17. *Want of potash.*—Probably more vineyardists agree upon attributing the shelling of grapes to a want of potash than they do upon any other cause advanced. There are several facts which favor the theory.

Potash is an essential element of plant food. Experiments carried on by Nobbe, Schroeder, and Erdmann* seem to prove conclusively that the office of potash in the plant economy is to assist in the formation of starch. Plants of Japanese buckwheat were grown in a solution free from all traces of potash. After a few

* Versuchs-Stationen, xiii. 1870, p. 357; cited by Goodale, *Physiological Botany*, p. 252.

weeks all growth had stopped. Examination of the plant failed to show any starch except traces in the green portion. When potash salts were added the plants began to grow again and starch was formed.

The development of sugar in fruits is dependent upon the presence of starch, for in the plant this substance is changed into the sugars, which sweeten the fruits. Some experiments have been made which have particular bearing upon this point. Dr. Stone, of the Massachusetts Agricultural College* makes the following statements: "A wild specimen of *Vitis Labrusca* (our common wild grape) was torn apart at its root; one half was left in its natural condition, the other transplanted to cultivated ground and treated with nitrate of potash and bone superphosphate. At the end of three years fruit from the cultivated vine contained twelve per cent. more potash and twenty per cent. more sugar than that from the wild one." Dr. Stone declared also that "potash fertilizers have decidedly improved the desirable qualities of our fruits. Wherever the percentage of this element has been raised the change is accompanied by an increase of sugar and decrease of acid." Other examples might be given, but these will answer for the present purpose.

All grape growers are agreed that the flavor of shelled grapes is none of the best; in fact such grapes are very insipid. Although this does not necessarily prove a lack of potash, the probabilities are that such is the case. All other causes which might produce such a result have been almost entirely excluded, so that we are apparently forced to accept this as the true cause of the difficulty. By a lack of potash is not meant necessarily that the soil is deficient in this element, but rather that it is not found in a form which makes it available as plant food.

The reasons for this want of potash are not very difficult to find. The lands upon which the majority of the Chautauqua vineyards are now growing had been used for many years for the production of grain and hay. Almost no fertilizers had been returned to the soil and the natural consequences followed. The supply of available plant food in the soil has become more or less exhausted.

*Amer. Gard. vi. 210 (1885), cited by Bailey, Agricultural Science, vi. No. II. 1892, p. 500.

In favorable seasons this may not be very apparent, but in seasons such as the past one, when the soil becomes dry and the quantity of available food in consequence more restricted, the effects of former croppings become visible upon lands which were not exceptionally rich in the first place. In the vineyard of Mr. S. Codington, of Fredonia, N. Y., this view of the case was very strongly emphasized. The vineyard is in the form of a square, and I was told that there was a strip stretching diagonally across the field from corner to corner, in which the vines shelled badly. Upon closer examination the line of shelling seemed to extend squarely across the vineyard in such a manner that about one-half shelled very badly, the other half but little. The portion which shelled the most was formerly used as a meadow and had been so used for fully twenty years. The other part had been set in the place of an old orchard which had been used as a cow pasture for more than twenty-five years. The line separating the orchard from the meadow could be traced plainly in the vineyard by the degree of shelling. There can be no doubt that much of the shelling is due to impoverished land.

It is not common to find a vineyard which was set upon old pasture or upon new land, that shells to any considerable extent ; most of these vines hold their fruit well and the contrary is the exception rather than the rule.

Fortunately we have proof that in some cases, at least, potash has stopped the shelling. But two examples can be here mentioned, but they are convincing.

Geo. W. Marsh, of Portland, N. Y., had been troubled with the shelling of his grapes for some years, on a rather low portion of his vineyard. Potash in the form of kainit was applied in the spring of 1894, at the rate of one pound per plant. This application seemed to be heavy enough, for the leaves did not show the "blight" during the following summer and the grapes did not shell in the fall. M. L. Taylor applied one ton of Canada hardwood ashes upon his vineyard ; it adjoins that of Mr. Marsh and is upon the same kind of land, but the applications were of practically no value. If the analyses of Canada hardwood ashes were always uniform, or if they invariably showed an abundant supply of potash, this result could hardly be explained. But in view of the success

which has followed the use of potash salts, I am inclined to believe that the ashes were not up to standard quality.

The second case is that of Mr. F. W. Howard, of Fredonia, N. Y. The experiment which was tried by Mr. Howard is one worthy of being followed by every grape grower in the Chautauqua district. He divided his Concord vineyard, which is practically level and is upon a soil very uniform in character, into several plots and applied fertilizers at the rate of two hundred pounds per acre, as follows :

16 rows, applied a mixture of equal parts muriate of potash and bone.

6 rows, muriate of potash.

6 rows, bone.

6 rows, tankage.

64 rows, equal parts tankage, bone, and potash.

7 rows, potash and bone.

4 rows, nothing.

These applications were made in the spring of 1894, upon land that had shelled in previous years. The results were so plainly marked that there was no room left for doubt as to the requirement of the land in this vineyard. The first plot of sixteen rows shelled, but not seriously. The next six rows, to which the muriate of potash had been applied, scarcely lost a berry, nor were leaves "blighted" to any greater extent than might be expected so late in the season. In passing to the next plot, the one to which the bone was applied, it was unnecessary to ask where the dividing line between the two plots was situated. The difference could be seen to the row. Where the bone had been applied, the berries shelled to such an extent that the ground was fairly blue in some places. It seemed as if fully one-third of the crop had fallen. The remainder of the plots showed improvements directly in proportion to the amount of potash used, the other materials applied being apparently without effect. The land upon which this vineyard stands was formerly used for farming purposes and was cropped continuously for fifty years or more with scarcely any fertilizers having been applied. The wonder is not that grapes shell, but that they do not all loosen their hold upon life and return to the soil from which they sprang.

GROUP IV.

Conditions of the atmosphere.

18. *Excessive heat.* If a very high temperature were the sole cause of grapes shelling, one should expect to find the shelling equally severe in vineyards having a similar exposure; and those vineyards in which the greatest heat occurred should show the worst shelling. But this is not the case. Some vineyards, and one belonging to Mr. E. H. Fay, of Brocton in particular, are so surrounded by trees that the south wind is the only one which can enter the vineyard freely. Mr. Fay told me that the heat in this vineyard was so intense that it is impossible for the men to work in it, and they are consequently given work elsewhere during the hottest days. The land has a southern exposure, it is protected on the north, west and partially on the east by trees, and it thus forms a pocket in which the heat accumulates sometimes to an intense degree. Yet this vineyard did not shell during the past season, with the exception of a small strip along the lower edge in which the soil was heavier and more moist.

19. *A south wind;*

20. *A west wind.*—These two causes have been advanced as being possibly responsible for the shelling. It has also been said that a north wind stops the trouble. At first thought it would seem that there can be no connection between shelling and the direction from which the wind blows. But, nevertheless, it is not impossible that such a relation may exist. A wind from the south or from the west is generally warm, and this warmth favors active growth and the development of the fruit. This activity of the plant may well be carried on at the expense of the fruit, especially if the supply of nourishment be limited. A north wind, being cool, would of course have an opposite effect, and check the plant's development.

Remedies.—After the above detailed discussion of the possible causes of the shelling of grapes it would appear that the one cause which appears to lie at the bottom of the trouble is *defective nourishment*. All influences which aggravate this condition may be held as being indirectly connected with the trouble, and they may even be the exciting cause of it. The drought, for instance, may

have had such an action on the supply of plant food that it prevented the plant from getting it, while if the season had been more favorable the vine might have pulled through and the owner would have been none the wiser.

The first step to take in order to remedy the shelling is unquestionably to study the needs of the soil in which the vineyard is growing. Mr. Howard is fully satisfied as to the needs of his vineyard, and it is very possible that his vineyard has suffered from shelling for the last time. I should hesitate to say that it is from a lack of potash that all the Chautauqua vineyards have shelled, yet it is probable that in a very large majority of cases this is the cause of the trouble.

Cultivation seems to have aggravated the trouble in soils which were not well supplied with all plant foods. It appeared to favor a growth which the plant was unable to ripen properly except at the expense of the fruit, for potash is as necessary to ripen wood properly as it is to add flavor to the berries. The much discussed subject of the amount of cultivation proper to a vineyard is here touched upon but cannot be discussed. The same rule will probably not apply to all vineyards; yet all cultivation which produces an excessive growth of wood and foliage should be avoided.

The weakening of vines by allowing them to overbear is another factor which seems to be responsible for some of the trouble. The young vines are the ones generally most seriously affected, probably because the roots do not penetrate into so much soil nor into such deep soil that a large food supply can be furnished the growing parts of the vines even under favorable circumstances. When young vines are allowed to bear heavy crops the food supply of those vines should be very carefully considered.

The powdery mildew was quite severe in many of the vineyards during the past season and a part of the shelling was without doubt caused by it. This mildew is one of the easiest to keep in check when it appears early in the season, but later attacks are more difficult to control as then there is danger of staining the fruit if late treatments are made. On page 441 will be found more definite directions regarding the treatment of this fungus.

Opinions of growers.—Having considered the possible and prob-

able causes of the shelling of grapes in a general way, it will be interesting to note how far actual cases will bear out the conclusions which have been reached. A circular asking for information was published and submitted to the growers of Chautauqua county. The following cases are replies, which have been received and also answers obtained in personal interviews. They are here stated in an abbreviated form but, on the whole, contain the most important portions of the answers. The most severe cases of shelling are placed at the end of the list.

Ralph Hall, Brocton. *Soil*, strong shale and loam; *Fertilizer*, applied four hundred pounds low grade potash to a vineyard that shelled in past years; *Shelling*, none in 1894.

Jonas Martin, Brocton. *Soil*, strong gravel loam; *Fertilizers*, experience has proved that shelling is not so serious when potash fertilizers are used.

G. H. Barber, Westfield. *Soil*, some gravel and some loam. This is inclined to be dry, and originally was strong land; *Fertilizers*, in the fall of 1892 applied two hundred pounds bone flour, and in the following spring two hundred pounds muriate of potash. Also some barnyard manure. The vineyards cover twelve acres. *Shelling*, none except from two rows situated fifteen feet from a row of apple trees, these being about six inches in diameter. *Probable cause*, the roots of the apple trees robbing the grapes of nourishment.

S. Dean & Bros., Brocton. *Soil*, generally a rather heavy gravel loam, formerly used for farming purposes; *Fertilizers*, have been using stable manure and potash fertilizers during the past ten years. Make applications of about three tons of good ashes per acre. Ten years ago one piece shelled badly; nearly a wheelbarrow load of manure was put about each of several vines and the next year these did not shell, while those around them did. *Shelling*, at present practically none.

Geo. W. Marsh, Portland. *Soil*, heavy gravel loam, inclined to be wet in a low place; *Fertilizers*, used kainit, one pound per plant; *Shelling*, practically stopped where it was formerly serious and no blight on the leaves.

E. Buckner, Brockton. *Soil*, mostly gravel loam; *Fertilizers*, not manured lately, but formerly well fertilized with stable manure. Hay and grain were raised on the land for about twenty years previous to setting the vineyard. *Shelling*, very little on the gravel, more on low, heavier land.

A. W. Lewis, Brocton. *Soil*, high gravel; *Fertilizers*, none for many years. The vineyard weedy and apparently somewhat neglected. The land was formerly used for growing hay and grain, the vineyard now being from twenty to twenty-five years old. *Shelling*, none.

L. Roesch, Fredonia. *Soil*, dry gravelly loam, naturally poor; *Fertilizers*, two tons Canada wood ashes per acre, also some stable manure; *Shelling*, none.

Henry Case, Brocton. *Soil*, gravel loam ; *Fertilizers*, applied two tons of Canada ashes in spring of 1894 upon seven acres ; *Shelling*, one part of the vineyard is eight years old and this shells ; the other part is thirty years old, but does not shell.

Hermion L. Kent & Co., Westfield. *Soil*, mostly dry clay, originally poor ; *Fertilizers*, yearly application of stable manure ; *Shelling*, none. Insects the probable cause of shelling, and not lack of vitality in the vines. Some of the very richest and best land has shelled grapes.

A. H. Harris, Westfield. *Soil*, rich, dry gravel ; *Fertilizers*, one pound sylvinit to the vine ; *Shelling*, none where potash was used, some where it was not used.

A. N. Taylor, Westfield. *Soil*, a dry gravel, naturally rich ; *Fertilizers*, potash at the rate of four hundred pounds per acre ; *Shelling*, less than one per cent.

Professor W. A. Holcomb, Ripley. *Fertilizers*, applied one ton of sulphate of potash on ten acres in 1893, and this year a light dressing of wood ashes ; *Shelling*, none.

O. J. Tefft, Ripley. *Soil*, gravel with low places ; *Fertilizers*, used one quart of good maple ashes per vine ; *Shelling*, most of the vines shell, particularly in the low muck ground.

G. Schoenfeld, Westfield. Formerly had charge of a vineyard. *Soil*, gravelly loam ; *Fertilizers*, one, to one and one-half pounds of muriate of potash applied in the spring to the vines which shelled the fall before, stopped the trouble.

E. W. Skinner, Portland. *Soil*, gravelly loam ; *Fertilizers*, applied half a pound of German potash salts to plants when they were set several years ago. About the same amount used again in 1893. *Shelling*, nearly twenty per cent.

J. A. H. Skinner, Brocton. *Soil*, 1, a heavy sandy loam, rather low, and formerly used for pasture ; 2, a gravel loam, high ground, formerly used as a garden ; 3, a lighter soil used for raising grain ; 4, shale loam, upon which stood an orchard ; *Fertilizer*, none ; *Shelling*, piece 1, none ; 2, about 5 per cent. ; 3, from 15 per cent. to 25 per cent. ; 4, none along the borders of the vineyard, from 1 per cent. to 10 per cent. in the interior.

Chas. Payne, Brocton ; *Fertilizers*, much stable manure used continually ; *Shelling*, the vineyard was set three years ago. This year it set heavily and shelled severely.

A. Kelly, Brockton. *Soil*, varies, sand, loam, clay ; *Fertilizers*, applied two hundred pounds raw bone meal per acre where the plants were set six years ago. Since then four hundred pounds of potash have been applied twice. *Shelling*, about 5 per cent., there being apparently no difference in severity on the different soils.

George S. Kent, Westfield. *Soil*, a loam inclined to be heavy and poor ; *Fertilizers*, mostly horse manure for several years. Last year used on a part sulphate of potash costing \$50 per ton, and some years before ashes to a considerable extent. *Shelling*, none except on three or four Concord vine

growing in an alluvial deposit of several inches of dark soil. It is the richest part of the vineyard and I never added manure thinking it needed none.

E. H. Fay & Son, Portland. *Soil*, side hill of loam and coarse gravel inclined to be dry. It is rather shallow and poor and was used not less than fifteen years as a cattle and horse pasture; *Fertilizers*, none. *Shelling*, only occasionally a bunch.

T. J. Walker, Ripley. *Soil*, both gravel and clay soils, well drained and fairly rich; *Fertilizers*, applied potash in 1893 at the rate of one pound to the vine, and also stable manure. *Shelling*, about 1 per cent.

A. W. Rumsey, Westfield. *Soil*, rolling, the hollows being of soil worked down into them, and all quite well drained; *Fertilizers*, a very little stable manure. *Shelling*, about 1 per cent., occurring mostly in the lower parts of the vineyard. *Probable cause*, a superabundance of foliage absorbing all the moisture during drought at the expense of the fruit.

Fraser & Co., Westfield. *Soil*, gravelly loam and sandy loam. Was cropped in parts for many years with grain and hay; *Fertilizers*, wood ashes and bone in some sections, muriate of potash and mixed fertilizers in others, and occasionally a little compost of stable manure. *Shelling*, lost by shelling probably 2 per cent. to 3 per cent.

A. B. Hawkins, Ripley. *Soil*, dry gravelly loam, naturally rich; grain and grass grown for many years; *Fertilizers*, animal manures. *Shelling* from 2 per cent. to 5 per cent., but where the manure was applied the grapes did not shell.

Jno. W. Spencer, Westfield. *Soil*, shaley clay with bed rock within thirty inches of the surface; *Fertilizers*, two years before being on the vine applied a shovel of stable manure to each plant each season. First crop nothing; second crop, four hundred pounds muriate of potash and four hundred pounds bone on one and three-fourths acres; third crop (1894) one hundred pounds un'each'd hardwood ashes on the same land. *Shelling*; shelling goes by plants, some plants 50 per cent., average 5 per cent. on piece of one and three-fourths acres. [While in conversation with Mr. Spencer he said that the worst shelling was in those portions of the vineyard in which the underlying rock came nearest the surface. E. G. L.] *Probable cause*; fungous disease on part or whole of them; plants not having proper formula of food are most susceptible to disease.

Chas. E. Brown, Ripley. *Soil*, rich black loam, rather wet; *Fertilizers*, heavy dressings of barnyard manure. *Shelling*, 5 per cent. *Probable cause*; might be mildew, is usually worst where vines have the most foliage.

B. M. Taylor, Portland. *Soil*, mostly rich, dry gravel with occasional hard loam in low places; *Fertilizer*, one portion barnyard manure, another salt and ashes. *Shelling*, none. *Probable cause*, drought and want of fertilizer. One of the worst vineyards I had last year received a good dose of salt and ashes and this year it has the best fruit of any and does not shell.

R. G. Wright, Westfield. *Soil*, rich black loam, clay subsoil. *Fertilizers*, not any until last spring when I applied potash at the rate of five hundred

pounds per acre upon one-half, and fourteen two-horse loads of rich horse manure upon the other half. *Shelling*, none, except six rows which I did not fertilize. These shelled badly.

M. L. Taylor, Portland. *Soil* similar to that of Mr. Geo. W. Marsh and adjoining it. *Fertilizers*, applied one ton Canada ashes in 1893 and in 1894 repeated the application. *Shelling*, apparently not benefited by the ashes and about 40 per cent. of the grapes dropping in the worst portions.

S. S. Grandin, Westfield. *Soil*, a dry shale, originally not very good; used about 10 years in raising grain. *Fertilizers*, on the shale none. *Shelling*, 30 per cent. to 40 per cent. On other land that was manured the shelling was from 13 per cent. to 20 per cent.

E. H. Fay & Son, Portland. *Soil*, low, flat land consisting of rich, black muck. It was used for growing hay for twenty-five years before the vineyard was set. *Fertilizers*, none. *Shelling*, about 20 per cent. *Probable cause*, extremes of wet and dry weather.

E. D. Warner, Forestville. *Soil*, part gravel and part muck mixed with loam, this last being inclined to be wet. *Fertilizers*, the land has had barnyard manure more or less for twenty-five years, during which time it was used for meadow. Last fall, and the fall before, applied one shovel barnyard manure about each plant. *Shelling*, from 12 per cent. to 25 per cent. of the crop. *Probable cause*; about here the vines do not shell so much on clay land as upon other soils; they seem to be worse also upon richer lands. There is a meadow on the west side of my vineyard and the two rows next the meadow do not shell; the third row but little, and the trouble increases towards the center of the vineyard. Nor is there any shelling at the ends of the rows.

Franklin Peck, Westfield. *Soil*, not very good and naturally rather poor. *Fertilizers*, none worth mentioning. *Shelling*, 20 per cent.

Frank Maginnis, Portland. *Soil*, clay loam, poor, thin, and dry. During four years previous to setting the vineyard the land was sown to oats, two hundred and fifty pounds of phosphates being used to the acre. The average yield of oats was thirty bushels per acre. *Fertilizers*, in setting vines used high grade phosphates; in 1893 used twenty-five hundred pounds of high grade potash on ten acres. That is the part that has shelled the worst. Have used no other fertilizers in six years. *Shelling*, nearly 25 per cent.

R. A. Hall, Brocton. *Soil*, black rich loam, rather wet. *Fertilizers*, none. *Shelling*, 50 per cent.

C. M. Whitmier, Brocton. *Soil*, gravelly loam, well drained. *Fertilizers*, applied liberal quantities of a mixture of tankage, bone meal, dried blood, and sheep manure to the first row or each side of a road passing through the vineyard. *Shelling*, very little on the treated rows, 20 per cent. to 30 per cent. on the rows back of the first ones.

B. POWDERY MILDEW.

(*Uncinula spiralis*.)

The appearance of this mildew has been described on page 423. The fungus begins to attack the grape early in June and then continues to spread with greater or less severity throughout the growing season. Dry weather seems to assist in holding it in check, and warm rains are sometimes followed by very severe attacks.

The early applications which were formerly recommended in the treatment of most of the diseases of the grape are not now so strongly insisted upon. For the treatment of the powdery mildew, the following applications should be sufficient. The Bordeaux mixture or the ammoniacal carbonate of copper may be used (see page 450, 451). It is perhaps better to use the Bordeaux early in the season, and later the ammoniacal solution.

First application, about a week before the blossoms open.

Second application, about a week after the blossoms fall.

Third application, about two weeks after the second treatment.

Fourth application ; in many cases this can be omitted entirely. The time for making it cannot be definitely stated, but it may be required some time within two to four weeks after the third.

Mr. J. A. H. Skinner, of Brocton, has been very successful in controlling this mildew by the use of the ammoniacal solution alone. As this is much more easily applied, it may be safe to use it exclusively. In making the applications care should be taken to *strike the clusters* as well as the foliage, for where there is none of the fungicide there the mildew has a chance. Later in the season the application should be directed more to the foliage, for fear of staining the fruit.

As yet, the Chautauqua vineyards have been apparently almost free from other fungous diseases and the advisability of spraying is an open question. During the past season the powdery mildew does not seem to have been sufficiently severe to warrant spraying beyond exceptional cases. What the conditions will be next year it is impossible to say.

C. ANTHRACNOSE.

(Sphaceloma ampelinum.)

Upon certain varieties, as Moore's Diamond, Brighton and others, anthracnose is sometimes very severe. It attacks the green stems, leaves and fruit, and sometimes causes a total loss of the crop.

The first indication of the disease upon the stems is the appearance of small dark brown or black spots, sunken in the central portions. These spots enlarge, generally extending up and down the stem, thus forming oval-shaped areas. Sometimes, however, the disease encircles the stem in such a manner as to girdle it and the result is similar to that which would occur if the girdling had been due to some other cause. This form of the disease is particularly prevalent upon the stem of the grape cluster. Here it is sometimes called "ring-around." As the disease progresses, the central portion of affected areas becomes more sunken and finally assumes an ashen color, only the edges of the affected part retaining the dark color.

On the fruit, the first stages are similar to those in the stem. The affected part is, however, often surrounded by a band having a reddish tinge and the center does not always assume the same ashen color, but it remains rather a dark brown. The diseased surface is quite smooth, and sometimes measures a quarter of an inch in diameter. If the berry is attacked while young, or if attacked in several places when grown, it is of no commercial value.

Anthrachnose of the grape is the most obstinate disease which the New York vineyardists have to combat. No authenticated cases are on record showing that the disease has been successfully treated by the use of the Bordeaux mixture or of any other fungicide after the foliage has expanded. In fact, I do not know of a single case in which the disease has been kept under control in this state, whatever the method followed.

The anthracnose of the grape is probably of European origin. It was introduced into this country fifteen years ago or more, and has since spread into most sections in which grapes are grown. In Europe it has long been successfully treated, but whether the same remedies will answer equally well in this country still

remains to be seen. The following is the method commonly employed by the foreign vineyardists :

Early in spring, just before the buds begin to swell, the arms and canes, including the buds, are treated with a solution made of sulphate of iron (copperas), sulphuric acid, and water in the following proportions :

Sulphate of iron,	110 pounds.
Sulphuric acid (commercial),	1 quart.
Water (hot),	26 gallons.

Care must be taken first to pour the acid upon the sulphate of iron crystals, and only then the water may be added. Otherwise there is danger of the water and acid being spattered when the two come in contact. This solution should be used the day it is made, for the iron sulphate will re-crystallize upon cooling if the liquid is allowed to stand any length of time.

Owing to the caustic properties of this solution it cannot be applied with our common spray pumps. The method followed in France is to tie a bundle of rags at one end of a stick and with this swab the vines are carefully treated. All portions of the vine that are covered turn black and in case the work has not been well done another application is made, but only the light-colored portions then receive attention.

The principal objection to this remedy is its expense and this will prove a serious drawback to the adoption of the method in this country. The vines can scarcely be injured by the application for I have used a similar solution which contained ten per cent. of sulphuric acid upon swelling buds, to the injury of about one-half of them. This remedy will be given a further trial and reported upon.

PART II—IN CENTRAL NEW YORK.

ANTHRACNOSE.

POWDERY MILDEW.

SHELLING.

These troubles are found to a limited extent in central New York, but the conditions are so similar to those in Chautauqua county that what applies to one region will apply to the other also. But other diseases have also been present this year and they will be briefly discussed.

D. BLACK ROT.

(*Leptostadia Bidwelli*.)

Black rot was very prevalent in the vineyards situated on the banks of most of the lakes of central New York. Some untreated vineyards lost from fifty to seventy-five per cent. of the crop from this disease, and even some treated vineyards showed a large amount of worthless fruit. Some vineyardists have said that the more the vines were sprayed the worse the rot became and many feel discouraged over the results of the season's work.

The black rot fungus attacks the berries most severely. Upon them it first manifests itself, generally when the berry is about full grown, by producing a brown or purplish spot upon one side. This color gradually extends over the entire berry and in the course of a few days the surface assumes a uniform dark brown appearance, which is deeper, however, in the portion first affected. This part begins to turn darker and produces many small, black pimples, these being a very characteristic feature of this disease. The berry now begins to shrink and dry, but it remains hanging on the stem until late in the season, sometimes throughout the winter.

"In the leaf the fungus causes well defined reddish brown spots of varying size, usually rounded in outline, and dispersed on the parts between the principal nerves. These spots usually

appear some days or even a week or two before the berries are attacked. On the young shoots and leaf stalks it effects characteristic changes in the form of elongated, very dark brown or black spots, which are slightly depressed owing to the absorption of the juices from the cells composing the underlying tissues,

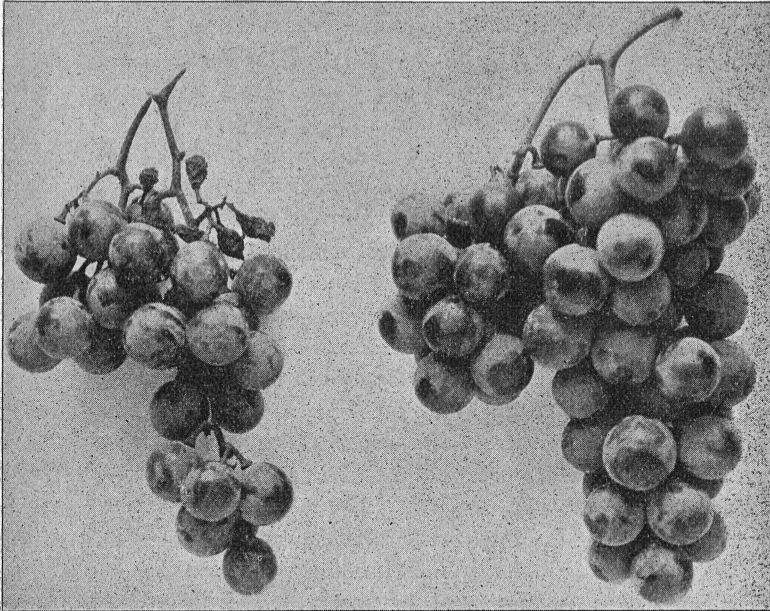


FIG. 5.—*Catawba clusters and black rot.*

Not sprayed.

Sprayed.

over the surface of which the characteristic pimples or pustules are more or less thickly scattered.”*

The treatments for the black rot are very similar to those mentioned on page 441. One fact should, however, be kept constantly in mind: the black rot is a very energetic disease and a berry affected with it is ruined. The fungus does not appear until rather late in the season, generally not until the fruit is fully two-thirds grown. This makes later applications dangerous on account of the necessary staining of the fruit. It is therefore

* Scribner. *Fungous Diseases of the Grape and Other Plants*, p. 10.

essential for the satisfactory control of the black rot that the early application be made *as thoroughly as possible* and upon the same dates as given for the first treatments of the powdery mildew. If the rot is feared, the last applications should be made more frequently, and as long as there is no danger of a permanent staining of the fruit the clusters should be thoroughly treated. The ammoniacal carbonate of copper should be used after the middle of July, or the first of August at the latest. It is better to use the Bordeaux mixture early in the season. The total number of applications necessary to control the black rot varies from three to seven, depending upon the dampness and temperature of the summer months. In warm weather, when the air and soil are kept moist by frequent showers, the disease often spreads with extreme rapidity, and under such conditions the treatment must be repeated every seven to ten days. Among some Seneca lake vineyardists there has arisen the impression that the more they spray the worse the rot becomes. Such a state of affairs is of course impossible. The applications made were probably not followed by as good results as was expected but that must be the fault of the operator and not of the mixture. One cause of this trouble was quite evident. The vines were a mass of foliage, so that it seemed impossible to reach the individual clusters in spraying. The land was also very rich in nitrogen so that the conditions were favorable to fungous growths. The absolute necessity of thorough work cannot be too strongly emphasized. Figure 5 represents two clusters of Catawbas, the one on the left not treated, the one on the right treated according to the above directions. In this case absolute protection was afforded by the spray.

E. BROWN ROT, GRAY ROT.

(*Peronospora viticola*.)

This disease is also caused by a fungus which thrives upon all the green portions of the grape.

It may attack the berries any time during the growing season but is as a rule more serious early in the summer. Diseased berries stop growing and soon becomes covered with a mealy substance which gives them a gray appearance. This has caused the disease to be called a gray rot. When the berries are more

advanced at the time the fungus attacks them they turn brown, which has given rise to the name of brown rot, and the gray appearance is not always present. Figure 6 shows two clusters of Niagara grapes attacked early in the season.

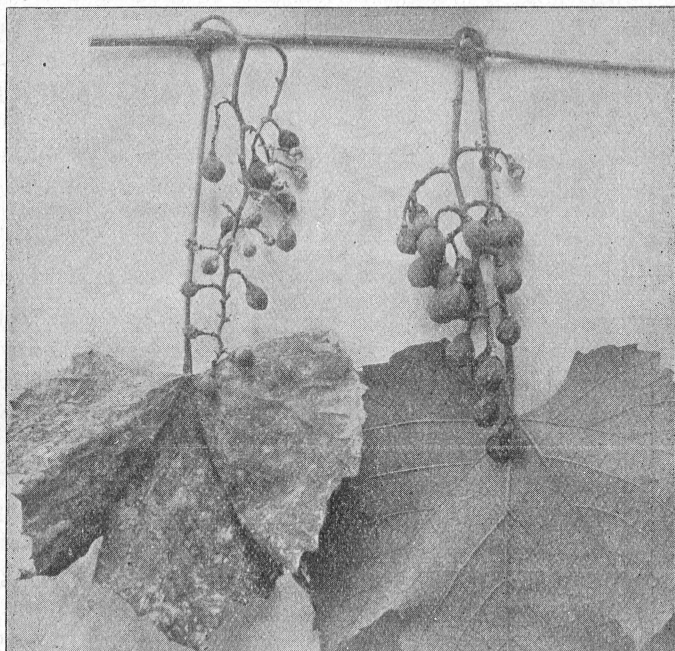


FIG. 6.—*Young Niagara clusters attacked by brown or gray rot.*

The leaves and young shoots also suffer early in the year but the worst time for them appears to be during July. Still I have seen comparatively fresh growth of the fungus as late as October, so that there is danger from the disease so long as there are green portions upon the vine. The fruiting portion of this fungus appears upon the under side of the leaves in the form of gray, downy growths. Directly above these the upper side of the leaves show yellow discolorations which soon turn brown as the affected part of the leaf dies. These areas are quite sharply defined, and the entire leaf does not change color in consequence of such diseased portions.

The stems when mildewed show the same gray appearance on their surface as is seen on the under side of the leaves. In severe cases the fungus kills the stem outright beyond the diseased portion, and a general browning of these parts takes place.

The downy mildew is not so serious late in the season as is the black rot, and this necessitates particular care in making the early applications. The Bordeaux mixture and the ammoniacal carbonate of copper are the safest fungicides to use. The applications should be made as already recommended for the powdery mildew, but greater thoroughness must again be insisted upon, as the disease is more serious than the powdery mildew.

F. RIPE ROT.

(*Glœosporium fructigenum*.)

A disease which to all appearances was the ripe or bitter rot of grapes was seen in some vineyards about Keuka lake. This year the injury done was not serious, but it is evident that the disease exists in this region and it may cause severe losses if the proper conditions for its development are present.

Affected berries change color in the portion first attacked, and this discoloration gradually spreads over the entire berry changing it to a reddish brown. Here the berry remains and shrivels, often hanging to the stem until quite dry, or sometimes dropping to the ground as soon as the shrivelling begins. Pimples appear on the surface of the shrunken portions, but such berries can be distinguished from those attacked by the black rot by their not being of such a black color. They are generally a clear brown or deep purple.*

This disease appears to attack grapes later than does the black rot, which makes it rather difficult to control. But the applications designed for black rot, if thoroughly made, will also check the progress of this disease.

G. DROUGHT.

In several vineyards on the shores of Canandaigua lake were noticed vines which had lost most of the lower leaves from the

* Scribner; *Ibid.* pp. 38, 39.

canes, thus leaving the fruit entirely exposed to the direct rays of the sun. The trouble seems to have begun during the latter part of summer. The leaves turned yellow and then brown, this last color generally appearing in those parts of the leaf situated farthest from the main veins. One-half of the leaf was in some cases destroyed before the other part seemed to suffer. The majority of such cases seemed to occur in portions that were directly exposed to the full force of the sun's rays. Such leaves were more or less curled, or they were so placed that one part shaded another. As a rule, the shaded portion did not suffer much until the part that received the sunlight was very seriously affected. Then the whole leaf gradually yielded to the trouble. The final result was that all the more seriously affected leaves eventually dried and fell from the vines, giving the vineyard a thin and unhealthy appearance.

The cause of the trouble was probably the dry weather, for the thinner the soil and the more it dried out, the worse the trouble seemed to become. Some entire vineyards were injured, others suffered only in certain portions, and those which were upon moister ground did not suffer at all. As soon as the fall rains came, the falling of the leaves immediately stopped.

Any cause which will tend to retain moisture in the soil will lessen the severity of the trouble. The worst case seen was in a Delaware vineyard that had received apparently no cultivation. If a thin mulch of cultivated soil had lain upon the ground, the evaporation would not have been so great and the vines would not have suffered as they did. More expensive and effective remedies can hardly be recommended at present.

PART III—MACHINERY FOR SPRAYING—FORMULAS.

The machinery to use in spraying vineyards and other plantations should be as simple and effective as possible. Three general styles are now in use ; knapsack pumps, hand pumps, and power sprayers.

The knapsack pump is probably the most effective, for the spray is entirely under the control of the operator and the work can be done as thoroughly as desired. It is open to the objection of being hard to carry and to work, and it is also very slow.

The hand pump, when placed on the side of a barrel and mounted in a wagon, makes a very serviceable outfit on level ground. It allows the use of two nozzles, and possesses greater power than the knapsack. A good arrangement is to have one man drive and hold one nozzle while the other man pumps and holds the other nozzle.

Power sprayers are the easiest to use, for in them the horse does the pumping. My experience with these has been such that I am convinced that for all low growing plants they are the most satisfactory machines to use. They must be adapted to the work, and be properly built and handled to give the best results. If a good machine is used, the work will be done about as effectively as with a hand pump, and much more easily. Some New York vineyards have been kept practically free from fungous diseases by their use.

The best nozzles for such work are probably the Vermorel, the McGowen, or the Bordeaux. These can be graduated, are easily cleaned, and are durable.

FORMULAS.

Bordeaux Mixture.

Sulphate of copper, 6 pounds.

Quick lime, 4 pounds.

Water, 40 to 50 gallons.

Dissolve the sulphate by hanging it in a bag in the liquid at the top of a wooden or earthen vessel full of water. One gallon of water will dissolve from one to two pounds of the sulphate. The lime should be slaked in an equal volume of water and when the

two are ready they can be poured the one into the other and then thoroughly stirred.

Another way of making the Bordeaux mixture has recently come into use. The sulphate of copper is used at the same rate as above but it is dissolved so that every gallon of the solution shall contain one pound of the sulphate. Then for the above formula six gallons would be taken and to this milk of lime is added until the ferro-cyanide of potassium will not discolor the mixture when a drop or two are added to it. So long as there is not sufficient lime present the test will show a dark brown discoloration where the material falls. When enough lime has been added no change takes place. The test solution is made by dissolving about an ounce of the ferro-cyanide of potassium in a pint of water. Only a drop or two need be used at a time, when making the mixture. I should recommend adding more lime than the test shows to be necessary, for from the experience of the past season the Bordeaux mixture has in some cases done serious damage to fruit. This subject will be more fully discussed in a future bulletin.

Ammoniacal Carbonate of Copper.

Carbonate of copper, one ounce.

Ammonia, enough to dissolve the copper.

Water, nine gallons.

The copper carbonate should first be moistened with a little water and the ammonia then added. This stock solution should be kept tightly corked until used. It will keep indefinitely. When wanted, dilute to the required extent with water, and apply.

Iron Sulphate and Sulphuric Acid Solution.

(French, for Anthracnose).

Sulphate of iron, 110 pounds.

Sulphuric acid (commercial), 1 quart.

Water (hot), 26 gallons.

First pour the acid upon the iron crystals and then add the hot water. As soon as the crystals are dissolved the solution is ready for use and should be applied the same day if possible. Do not apply this by means of metal apparatus for the acid will corrode

and render it worthless. Apply with a cloth swab, and only to dormant plants.

SUMMARY.*

PART I.

1. The shelling of grapes occurred to a very serious extent in 1890 and 1894. Page 418.

2. This disease is probably not identical with *apoplexie* or with *rougeot*, two diseases occasionally present in French vineyards. Pages 420, 421.

3. Insects do not cause the disease. Page 423.

4. Fungi, especially the powdery mildew, may aggravate the condition to a limited extent, but they cannot be held as the prime cause of the trouble. Page 423.

5. The "blight" or unnatural dying of the foliage is not the cause of the malady, but is probably a manifestation of the action of the same causes which produce the shelling of the grapes. Page 424.

6. The stems shrivelling before the berries mature is another condition produced by the same cause. Page 425.

7. The premature ripening of the berries is due to the same causes as the blight of the leaves and the abnormal condition of the fruit stems. Page 425.

8. The premature ripening of the wood, while it may to a certain extent be the cause of the shelling, can scarcely be considered as the fundamental cause of all the trouble. Page 425.

9. Vines which are allowed to overbear are probably more liable to shell than are those not in the same condition. The weakening of a plant causes it to succumb more easily to unfavorable conditions. Page 425.

10. Too much wood may increase the extent of the trouble, for when the wood ripens it apparently takes its required nourishment at the expense of the fruit. Page 426.

11. Too rich land will scarcely cause shelling provided the

*NOTE.—The conclusions regarding the shelling of grapes have been drawn almost entirely from one season's observations, and the subject should receive further attention in the future.

available food supply is present in proper proportions for the use of the plant. Page 426.

12. Nitrogen apparently increases the amount of shelling. Lands which are rich in this element of plant food seem to suffer more than those growing in land that makes a smaller growth of wood. Page 427.

13. The shelling of grapes upon soils rich in nitrogen is probably not due to an inherent tendency of the nitrogenous food to produce shelling, but rather to a faulty ratio between the amounts of available plant food. Page 427.

14. The kind of soil, not considering the food supply contained in it, does not appear to exercise any marked influence upon the degree of shelling. Page 427.

15. Too much cultivation seems to aggravate the trouble, probably on account of the larger amount of nitrogenous food liberated by the operation. Page 427.

16. Excessive drought alone cannot be held as the sole cause of the trouble, although it is probable that the dry weather caused the loss to be greater than it would otherwise have been. Page 428.

17. Excessive rains after a prolonged drought may have influenced the severity of the shelling but to what extent is not known. Page 429.

18. A weak root system would have an effect upon a plant similar to that exercised by allowing it to overbear, and a like tendency towards shelling would exist. It seems probable from the fact that young vines, as a rule, shell the most, that the limited root system may be in part responsible for the trouble. Page 429.

19. A want of barnyard manure has been ascribed as a cause, and the trouble, in one case, has been stopped by its use. Page 431.

20. No evidence at hand goes to show that shelling is due to a want of phosphoric acid. Page 431.

21. Many vineyardists have apparently stopped the shelling by applications of potash. Page 431.

22. Potash seems to be the food required by the plant in the majority of the cases in which the vines shell and it may be wanted in all cases. Page 432.

23. The principal reason for this lack of potash is undoubt-

edly the continuous cropping to which most of the shelling land was submitted before the vineyards were set. Page 432.

24. Excessive heat of itself did not cause the shelling. Page 435.

25. A warm wind, one which would have a tendency to excite active growth, might have a tendency to increase the shelling. Page 435.

26. A cool wind or cool weather, on the contrary, may stop the trouble to a considerable extent. Page 435.

27. Powdery mildew was quite prevalent in Chautauqua county in 1894, but it is certain that the usual remedies will check the disease. Pages 436, 441.

28. Anthracnose is serious in some localities and it is recommended that growers make a trial of the acid sulphate of iron solution, as described on page 443.

PART II.

29. Shelling, anthracnose, and powdery mildew exist also in the lake region of central New York. The remedies already mentioned are recommended.

30. Black rot, brown rot, and ripe rot appear to have done some injury in this region during the past season, and the usual remedies are recommended. Pages 444, 446, 448.

31. The failure of some vineyardists to prevent these diseases was probably owing to a too heavy growth of foliage, and to improper methods of making the applications.

32. Drought caused some vineyards to suffer severely. Shallow and frequent cultivation is probably the most practical method of counteracting this influence. Page 448.

PART III.

33. A knapsack sprayer is the most effective machine, but it is the hardest to work and the slowest in covering the plants. Page 450.

34. Hand pumps allow of much more rapid work, but the work is not always so effective. Page 450.

35. Power sprayers, under favorable circumstances, are the most desirable machines for spraying vineyards. Page 450.

E. G. LODEMAN.